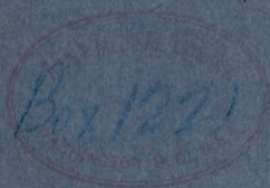


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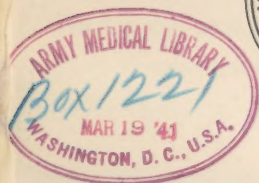
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CITRUS FRUITS and HEALTH

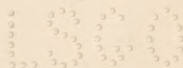
Clinical and Scientific Data from
the Literature of Nutrition as
related to Citrus Fruits

Compiled for the use of the
Medical and Dental Professions



FLORIDA CITRUS COMMISSION
STATE OF FLORIDA
LAKELAND

[1940?]



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CITRUS FRUITS AND HEALTH

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FOREWORD

The Florida citrus industry owes much to clinicians and scientists, whose observations and experimental studies have provided the rational basis on which physicians, dentists and nutritionists now recommend citrus fruits as a valuable dietary supplement in health and disease.

In acknowledgment of this debt, and in appreciation of the service rendered by the professions, the industry has taken steps to encourage further research in the field of nutrition as related to the citrus fruits. To this end the Florida Citrus Commission has obtained the counsel and cooperation of an advisory board which includes internationally recognized authorities in medical and dental research, nutrition, and biochemistry; and during the past three years it has made grants to outstanding scientific institutions for new studies on the health values of citrus products.

Articles pertaining to the use of citrus fruits in medicine and dentistry have accumulated in the literature for many years. Most of these reports refer to oranges, since this fruit has been known for centuries as a staple part of the diet in many countries of the world.

Grapefruit, on the other hand, is a relative newcomer, and it remains to acquaint the medical profession with its equally valuable properties. For example, although its percentage content of Vitamin C is somewhat lower than that of the orange, owing to its larger size the total quantity of Vitamin C *per fruit* exceeds that of the orange by almost 60 per cent.

Tangerines also contain a high percentage of Vitamin C, and they surpass other citrus fruits in their content of calcium and the carotenes.

The grapefruit need no longer be classed as a luxury, for, with increasing production, its quality has been enhanced while at the same time its price has been materially lowered. Indeed, at the present time, the grapefruit is no more expensive than the orange for equal health benefits.

Citrus fruits are a healthful natural food, supplementing and repairing the deficiencies of the usual American diet which is notoriously poor in vitamins and mineral salts. Therefore any dietary habit which will increase the consumption of these valuable fruits should benefit the public health. Counsel to augment the customary intake of fruit by the addition of grapefruit and tan-

gerines to the diet should help to raise the "ill-fed third" of the population to the "minimum" protective level of vitamin and mineral intake, and to increase the intake of the better-fed to that "optimum" level which is requisite for buoyant and abounding health.

The discovery of the vitamins, and the recognition of the essential importance of these and other accessory factors to human health, have produced in recent years an enormous number of reports dealing with the medical and scientific aspects of this subject. For example, over 1000 articles were published in the year 1937 on vitamins alone. While many of these studies pertain to the vitamins and minerals supplied by the citrus fruits, it is manifestly impossible to summarize such an extensive literature within the confines of this brochure. However, an attempt has been made to present briefly something of the physiology, pathology and therapeutics of the accessory substances as related to the citrus fruits, along with examples, figures, and opinions from selected clinical and scientific sources, and it is hoped that this book may prove of interest and value to members of the medical and dental professions, for whom it was written.

FLORIDA CITRUS COMMISSION
Lakeland, Florida

I N T R O D U C T I O N

Although the health-giving properties of citrus fruits have been recognized for centuries by physicians and laity alike, it is only within the past few decades that they have become available to more than a small percentage of the world's population. With constantly improved methods of production and increasingly better distribution facilities, a variety of citrus products of superior quality now come to market everywhere, and have taken an assured place in the diet of civilized man. Delicious, refreshing, attractive to sight as well as to smell and taste, they appeal to sick and well, adults and children alike; while their ready availability and remarkably low cost today make them an important dietary factor in the public health.

Hence it seems appropriate at this time to recapitulate our knowledge of these useful fruits, and to present data from the medical literature illustrating their dietetic value in normal health, growth, pregnancy, lactation and infant feeding, as well as their rise in the treatment of the sick and convalescent.

Addendum

Since the publication of this booklet, there has been completed in the laboratories of one of our great universities an extensive survey of Florida canned grapefruit and canned grapefruit juice. Many brands were analyzed, and the report indicates that these products may be considered the dietary equivalent of the fresh fruit. The Vitamin C content averaged 40 mgm. per 100 c.c. of juice, which is equal to the accepted value for fresh grapefruit. The amounts of calcium, phosphorous, other minerals, citric acid, and potential alkalinity were unaffected by the canning process. In the unsweetened products neither the carbohydrate nor the fuel values differed from those of the fresh fruit.

The statements in this booklet refer for the most part to fresh citrus fruit; the extensive survey considered above indicates that they apply equally well to canned grapefruit products. Canned grapefruit and canned grapefruit juice are delicious and of high nutritive value; their convenience and their availability throughout the year make them a welcome supplement to the fresh citrus fruits which are already a part of our national diet.

PUBLIC HEALTH ASPECTS

Low Level of American Diets

Steadily accumulating evidence indicates that in spite of the quantity and variety of food in the American diet, a large proportion of our population is living at or below the "adequate" intake level for vitamins and mineral salts, and far below that "optimum" level which is necessary for the most abundant and buoyant health. Boyd¹ states: "The American diet is decidedly below the standard of optimum adequacy. Even among those who can afford the best, many individuals receive poor diets."

Scurvy

The Committee on Nutritional Problems of the American Public Health Association² states that deficiency in Vitamins A, B, and C intake appears to be widespread and of frequent occurrence. Clinical and laboratory studies in many different parts of the country add weight to this indictment.^{3,4,5,6,7,8,9,10,11,12,13}

Diet Often Generally Deficient

Deficiency in but one dietary factor is rarely found. Strauss¹⁴ says: "It has often been pointed out that deficiency disease in man, unlike that produced experimentally in animals, is seldom limited to a single factor. A diet deficient in Vitamin B₁ may possibly be low in other portions of the B complex as well as in Vitamins A and C and in iron and minerals." Eddy and Dalldorf¹⁵ comment: "A human diet deficient in one vitamin is probably defective in others as well, and most cases of moderate deficiencies are therefore multiple." Haden¹⁶ states that symptoms resulting from deficiency in specific nutritional factors occur frequently, although clinical entities such as scurvy and beriberi are uncommon. He notes that almost every tissue of the body may be affected by deficiency of an essential food factor, and that deficiencies are usually multiple.

Mild Deficiencies Important

These deficiencies need not be great in order to have profound practical significance. Youmans¹⁷ says: "It is becoming better and better recognized that mild or latent forms of vitamin deficiencies are more im-

portant in practice than the fully developed ones. The latter are uncommon, are easily recognized, and are usually promptly and adequately treated. On the other hand there is reason to believe that minimal or mild forms are more frequent, often escape recognition, and, because of their insidious effects on large numbers of people, constitute a more serious problem than the occasional advanced case. Because of the probably high incidence of mild avitaminoses as complications of other diseases, they must be of vital interest to all physicians irrespective of the nature of their practices.”

Food deficiencies may be attributed to one or more of several factors:

Poverty

a) Owing to adverse economic conditions a certain percentage of the population must restrict their purchases to those foods, mainly carbohydrate, which will maintain life, without consideration for perfect health.

Faulty Habits of Eating

b) Man frequently chooses his food by its appearance and taste, without regard to health values or a balanced diet, and often his meals will be found to consist largely or wholly of refined carbohydrates and fats.¹⁸

Disease

c) In the sick and ailing the appetite is decreased and the food intake lessened, and there may be interference with the absorption and utilization of all or some of the food factors.¹⁹ At the same time there is usually greater need for certain food constituents, particularly the vitamins.^{15,20} In conditions such as obesity, diabetes, peptic ulcer, hypertension and allergy, restricted diet may be a necessary part of the treatment.

Normal Growth, Pregnancy and Lactation

d) In these conditions there is a greatly increased demand for all of the essential food elements;^{12,21} when these requirements are not met, deficiency states may, and frequently do, occur.

Change of Dietary Habits

e) Our ancestors ate large quantities of coarse natural foods and thrived upon them; modern "improvement" of foods by methods designed to enhance their attractiveness, flavor, and keeping qualities, has often deprived them, in whole or in part, of those essential factors upon which health depends.^{9,22} Moreover, cooking may destroy vitamins by heat and oxidation, while

minerals are thrown away with the water in which food is boiled or steamed.

Vitamins Preferable in Natural Foods

In the treatment of deficiency states the most important factor is a well-balanced, adequate diet, which can be supplemented when necessary by preparations containing vitamins and minerals in concentrated form. Too much emphasis cannot be placed on giving these substances in the form of natural foods.²³ Minot²⁴ says: "Today's knowledge does not permit us to prescribe with precision the amounts of the thirty-six or more substances which are required for correct nutrition. To detect deficiencies and remedy them piecemeal by supplements of manufactured concentrates will not at present solve the problem. Experience tells us that a mixed diet of natural foodstuffs, one especially rich in milk, green vegetables, fruit, butter, eggs, and food with ample protein of good biologic value, gives the best results."

In the United States deficiency diseases occur not so much because a sufficient amount of food is lacking, as because it is provided in highly concentrated, purified, and "improved" form such as white flour, sugar, puri-

fied oils, and foods "ready to serve." This limits the amount of food taken in the natural state, and it is in natural state that foods are richest in vitamins and minerals.²⁵

Citrus fruits are natural foods which do not have to be "improved" in order to appeal to the senses. Scientific methods of cultivation and modern distribution facilities bring the fresh fruit to the world's markets at surprisingly low cost. Their season is a long one, concentrated chiefly in winter when many other fresh fruits are not in the markets, while canned citrus products of great palatability and high nutritive value are available for use at any time.

Sources of Vitamins, Minerals, Carbohydrates

The health-giving properties of citrus fruits are traditional, and scientific studies attribute these qualities to their richness in mineral elements and vitamin values. For example, citrus fruits are outstanding sources of Vitamin C, good sources of Vitamins B and G, and may contain appreciable amounts of other vitamins. They also contain fair amounts of calcium, phosphorus and iron, traces of copper, magnesium and manganese, and 10 to 12 per cent of easily assimilable

carbohydrates in the form of dextrose, levulose and sucrose. Their natural and attractive tartness is due to citric acid (partly free and partly as natural citrates), which is burnt in the body to yield energy, leaving the base-forming elements as an alkaline ash to balance the acidity of acid-forming foods.²⁶

The following table shows the approximate amounts of some of these substances in Florida oranges, grapefruit and tangerines:

	Oranges	Grapefruit	Tangerines
	per 100 c.c. of freshly expressed juice		
Vitamin C*	50 mgm.	40 mgm.	35 mgm.
Vitamin B	20 Sherman units	20 Sherman units	No data
Vitamin G	Present	Present	No data
Vitamin A	Present	No data	Present
Calcium*	8 mgm.	9 mgm.	13 mgm.
Phosphorus*	17 mgm.	15 mgm.	12 mgm.
Carbohydrate**	11.6 gm.	10.1 gm.	—
Citric Acid	0.9 gm.	1.31 gm.	0.75 gm.
Potential alkalinity*	5 c.c.N/alkali	4.5 c.c.N/alkali	4.5 c.c.N/alkali
Fuel value**	52 calories	45 calories	—

(*Average amounts, compiled from various sources in the literature supplemented by original data based on 3 years' analyses of 394 boxes of the fruits.)

** Ref. 8

Citrus Helps Balance Diets

Bowden²⁷ writes of citrus fruits: "Their content of vitamins, minerals, organic acids, sugar and water, together with their final alkaline reaction in the body,

makes them most valuable in helping to meet the requirements of a well-balanced diet, the principles of which should be observed in every hospital diet, and not violated in any special diet. Their flavor and tartness make them most acceptable when other foods cannot be taken. No hospital that makes the welfare of the patient the primary consideration can afford not to have fresh citrus fruits play an important role in every patient's diet."

SPECIAL DIETS

In prescribing special diets for any cause, the physician must consider not only what foods are to be withheld, but also what factors must be added for the benefit and protection of the patient. All special diets should be carefully supervised in order to make certain that the essential vitamins and minerals are included, and in sufficient amounts.

Obesity Diets Frequently Lack Balance

Obesity diets are frequent offenders with respect to lack of balance, and since such diets are continued over long periods of time, there may be serious danger of the production of deficiency states. All obesity diets should include a liberal allowance of citrus fruits, both for their content of accessory substances, and because their alkaline residue in the body helps to combat the potential or actual acidosis which may accompany the rapid catabolism of body fat.

Vitamin C Augments Action of Insulin in Diabetes

Diabetic diets are frequently lacking in vitamins,²⁸

and since there is increased metabolism of Vitamin C in diabetes,^{29,30} the deficit in the organism is often found to be of considerable degree. Since the patient must remain on his diet continuously, great care should be taken to include in it all of the essential food factors. Vitamin C has been found to augment the action of insulin in diabetes, and to aid carbohydrate metabolism.^{31,32,33} Citrus fruits form an attractive and valuable addition to the diabetic diet, providing an abundance of Vitamin C together with other vitamins and minerals of use in this condition.

Citrus to Combat Hypoglycemia

In hyperinsulinism and overdosage with insulin, citrus juice is usually prescribed to combat the hypoglycemia. In this connection Joslin³⁴ sagely remarks that while the patient is peeling the fruit he has time to reflect as to whether he is actually experiencing a reaction due to an overdose of insulin, or not.

Subnormal Vitamin C in 90% Cases Peptic Ulcer

The long-continued bland diet of the ulcer patient, following the usual starvation period at the onset of the acute condition or after operation, is liable to

drain the organism of its vitamin stores,³⁵ and this at a time when large amounts of the accessory substances are needed to promote healing and restore normal function. This is particularly true when hemorrhage has occurred, for Vitamin C is also necessary for the formation of new blood cells.³⁶ Ingalls and Warren state that 90 per cent of their cases of peptic ulcer had sub-normal amounts of Vitamin C in the blood plasma.³⁷ In a series of fifteen cases of hematemesis and melena and in three cases of peptic ulcer Lazarus determined that all were in a condition of sub-clinical scurvy. He advises treatment of the acute condition with ascorbic acid, followed by orange juice during convalescence.³⁸

Treatment, Orange Juice and Milk

Portnoy and Wilkinson³⁹ studied the Vitamin C levels in 25 ulcer patients and 31 patients with hematemesis, by 6 methods, and noted that all showed severe Vitamin C deficiency. Chamberlin and Perkin's⁴⁰ series of 27 patients with peptic ulcer showed appreciably less Vitamin C in the blood than did normal controls. They feel that the administration of orange juice hastens the healing of the ulcers. Blankinship and Oatway⁴¹

treated ulcer patients with mixtures of milk and orange juice with highly satisfactory results.

Citrus Lowers Stomach Acidity

In reply to those who fear that citrus juice might raise the acidity of the gastric juice, Dimmler, Power and Alvarez,⁴² on the basis of in vitro experiments, state that the effect of citrus juice would certainly be in the direction of lowering the acidity of the stomach contents. The studies of Rivers and Carlson⁴³ suggest to them that lack of Vitamin C may predispose to peptic ulcer.

From these studies it is apparent that in peptic ulcer the body needs the materials which citrus juice can supply, and that one is warranted in adding citrus juice to the ulcer patient's diet as soon as the acute stage of the disease is past.

INFANCY AND GROWTH

Scurvy in Children

It is customary to add citrus juice to the infant's diet at an early age as a protection against manifest or latent scurvy due to a lack of Vitamin C. Scurvy is characterized by the inability of the supporting tissues to produce and maintain intercellular substance; the collagen of all fibrous tissue structure—the matrix of bone, dentine, tendons and cartilage, and possibly all endothelial cement substance including that of the vascular endothelium.⁴⁴ This weakening of the supporting tissues explains histologically all of the gross lesions of scurvy. Naturally the phenomena of scurvy are most pronounced in growing individuals, where continuous formation of intercellular substance is taking place in important locations. Frank scurvy may appear within the first three months of life, particularly in the case of premature and bottle fed infants,⁴⁵ while lesser degrees of Vitamin C deficiency are apparently of common occurrence.⁴⁶

"Minimum" Dose Vitamin Insufficient

While a comparatively small amount of a vitamin is sufficient to protect an individual, this "minimum" dose is far below the "optimum" quantity necessary for the highest health.⁸ Byfield and Daniels⁴⁷ showed that when the protective dose of orange juice administered to a group of infants was increased three times, there was a marked stimulation of growth; mere increase of calories in the diet was without effect.

Milk Poor Source Vitamin C

Milk cannot be considered a dependable sole source of Vitamin C for infant nutrition. Fresh human milk contains about 4 mgm. per 100 c.c.,⁴⁵ while freshly drawn cows' milk contains about 2 mgm. In both the amount is more or less dependent upon the dietary intake of the vitamin^{48,49} and varies with the season of the year, being greatest in summer when fresh fruit and vegetables are in season.^{48,50} Pasteurized human milk contains about 0.3 mgm. per 100 c.c., and pasteurized cows' milk sometimes less than 0.1 mgm.⁴⁵ An infant fed 500 to 1000 c.c. of fresh human milk daily would receive an adequate supply of Vitamin C (20 to 40 mgm.) provided the nurse's diet was adequate

in this respect; however, this is frequently not the case.^{48,49,50} If fed on pasteurized milk, either human or bovine, the child should be given orange juice to insure adequate Vitamin C.

Orange Juice from First Week

Ingalls⁴⁵ has found that scurvy may occur in infants as young as three months of age, and in premature infants even earlier. Hence he feels that the vitamin supplement should be added to the child's diet during the first week of life, especially in the case of premature infants, those artificially fed, and the ailing, the desirable dose (inferred from breast feeding and clinical experience) being 20 to 30 mgm. of ascorbic acid or its equivalent in 40 to 60 c.c. of orange juice.

Citrus Toleration High

Brennemann⁵¹ states that while the protective dose of orange juice is not precisely known, a large quantity does no harm; and recommends that it be administered within the first month of life, one-half ounce daily, increasing as rapidly as the child will tolerate it up to the juice of one orange a day. He adds that chemically pure ascorbic acid offers no advantage over orange

juice for oral administration, except in the rare instance of sensitivity to orange juice, and even then one is justified in disregarding the rash. The orange juice may be given undiluted, or mixed with water, or added to the milk formula; mixed with milk it forms the so-called "acid milk," in which the curds are smaller, softer, and more easily digestible.

During Rapid Growth Vitamin Demand Great

In the diets of older children also, citrus fruits are among the preferred sources of essential food elements. During the years of rapid growth the demand for vitamins and minerals is great;^{12,15,52,53} for example, Falk, Gedda and Göthlin found that children of elementary school age require approximately twice as much Vitamin C per kilo of body weight as do adults.⁵⁴ At the University of California Medical School it was found that many children who came to the clinic were on the borderline of inadequate nutrition, due often to economic status, racial habits, or individual idiosyncrasies which led to a very low consumption of Vitamin C containing foods. After 8 to 16 ounces of orange juice were added to the diet the members of this group showed a large gain in weight and general clinical improvement. The authors note that children

require a high Vitamin C intake, that their capacity to store it is very limited, and that fatigue and infection reduce this small reserve rapidly.⁵⁵ In Chaney's study of 200 underweight school children,⁵⁶ a mid-morning dietary supplement of orange juice was found more effective than milk for increasing the body weight. In 50 normal children Privitera⁵⁷ found that the addition of a multiple vitamin and mineral supplement to a good diet over a period of six months caused a weight increase twice as great as that expected.

CITRUS FRUITS AND CALCIUM ASSIMILATION

Citrus Facilitates Calcium Utilization

While milk is probably the best dietary source of calcium, the addition of citrus fruits undoubtedly facilitates the utilization of this important element and helps the body assimilate a greater amount and a higher percentage of the calcium in the food.

Chaney and Blunt⁵⁸ in 1925 reported that orange juice in some way favored the retention of calcium by growing children, and Eddy's animal experiments in 1933⁵⁹ supported the view that fruit juices have a supplementary effect in making more utilizable other factors in food mixtures.

Calcium Storage 8% Greater

The recent investigations of Lanford⁶⁰ have placed this belief on a firm experimental foundation. Young, growing rats were fed moderate amounts of orange

juice in addition to a basal diet of wheat and milk. Litter mates on the basal diet served as controls. After 32 days the rats were killed and the gains in body calcium carefully determined. The animals given orange juice grew, on the average, about 10 per cent more rapidly than did their litter mates on the unsupplemented wheat and milk diet. They also stored a distinctly higher percentage of the calcium provided by the food mixture than did the controls; and in spite of the fact that the orange juice slightly diluted the calcium of the diet so that they received less calcium than the controls, they stored a greater amount, as well as a greater percentage, of calcium. In other words, these animals, despite a slightly lower calcium intake, assimilated a greater amount and a higher percentage of the food calcium than did the control animals which received no orange juice. The proportion of the diet calcium stored under these conditions was about 8 per cent greater than the proportion stored by control animals on the basal wheat and milk diet. This is good evidence that the addition of such a citrus product to the regular diet facilitates the utilization and assimilation of the dietary calcium, and helps to maintain the growing body in the normal calcium balance which is necessary for the development of strong bones and sound teeth.

Increase Citrus With Age of Child

Four ounces of citrus juice or its equivalent in citrus fruit is suggested as the daily allowance for small children, increasing the amount with the age of the child up to one pint of citrus juice at age 12 and thereafter. It may be given advantageously between meals, since it does not dull the appetite for the regular diet, and it provides stores of minerals and vitamins in a form which appeals to every child.

Aldrich⁶¹ says: "The thoughtful physician of today must see to it that the children he cares for are taught to eat a wide variety of foods as little changed from the natural state as possible. In this way one would expect to supply adequate amounts of the known vitamins, and also the ones which future investigators will discover tomorrow."

PREGNANCY AND LACTATION

Mother Must Eat for Two

Normal pregnancy and lactation markedly increase the demand for all of the food elements, and during this period of some eighteen months the mother must live and eat for two. The fetus acts as a parasite; if its nutritional requirements are not met through the mother's diet, food materials are secured from the stores in her body even to the extent of breaking down the maternal tissues. Calcium, for example, may be taken from her bones or teeth.

Similarly, the concentration of Vitamin C in human milk is greater than that in the mother's blood, though it varies with variation in the blood content. Hence it might be possible in certain cases for the child to obtain an adequate supply of Vitamin C from breast milk even though the mother were suffering from a mild degree of vitamin deficiency. At birth the child's blood contains higher concentrations of iron, calcium, and other essential substances than exist in the blood of the

mother. The Vitamin C in cord blood is 2 to 4 times greater than that in maternal blood examined at the same time.^{62,63}

Well-Balanced Diet During Pregnancy

Throughout pregnancy and lactation the mother's diet is of primary importance. She must not only supply all of the materials for the growth and development of the child, but also maintain her own health in order to meet the stresses of parturition and the subsequent nutrition and care of the infant. To do this she must have a sufficient quantity of good food in a well-balanced diet. When the usual diet is not amplified during pregnancy, the intake of vitamins and minerals is below optimum or frankly deficient in 50 per cent of cases, according to a number of recent studies.^{62,64,65,66,67} A considerable proportion of women ordinarily live on a sub-standard calcium intake, and do not improve this intake sufficiently during pregnancy; an easily utilizable calcium reserve may be a very important factor in relation to parturition.⁶⁸

Vitamin C in Blood Diminishes in Pregnancy

Pregnancy increases the requirement for Vitamin B,¹⁴ and the lack of it may cause polyneuritis. As pregnancy

advances the amount of Vitamin C in the blood diminishes,^{64,69} showing an increasing demand. Nausea and vomiting are frequent concomitants of the early months of gestation and often interfere with adequate nutrition. In three cases studied by Teel, Ingalls and their associates,^{62,63} the blood plasma Vitamin C levels were within the range found in clinical scurvy. Lesser degrees of deficiency are common. Certain cases of hyperemesis gravidarum have been successfully treated with Vitamin C.⁷⁰ Peters⁷¹ lists hypovitaminosis as one of the causes of habitual abortion, and Ley⁷² has used Vitamin C with success in treating certain cases of this condition.

Citrus Daily During Pregnancy, Lactation

The pregnant woman and nursing mother require a generous Vitamin C intake so that the new born infant shall have an adequate store of the vitamin at birth and receive a sufficient supply during lactation,¹⁰ and this holds true for the other vitamins and the mineral salts. Citrus fruits equivalent to at least 1 pint of citrus juice daily should form a part of the well-balanced diet during pregnancy and lactation, their appetizing and refreshing qualities making them particularly acceptable

during this long period of unusual strain. Citrus fruits may be taken as mid-morning and mid-afternoon nutriment without affecting the appetite for the next meal.

T H E T E E T H

Dental Caries and Pyorrhea

Although the cause of tooth decay is still an unsettled problem, there is a mass of clinical and experimental evidence proving that the incidence of dental caries and pyorrhea is far less when the diet includes an abundance of natural foods containing the essential vitamins and mineral salts. Scurvy is an example of the lack of but one of these essentials, and among its cardinal signs are spongy, bleeding gums and loosening of the teeth in their sockets.

Scurvy and Pyorrhea

Boyle, Bessey and Wolbach⁷³ found that in the type of pyorrhea characterized by loosening and wandering of the teeth, general damage to the peridental membrane, resorption of alveolar bone, and depletion of the hematopoietic cells of the bone marrow, the changes were histologically identical with those found in unquestionable cases of infant scurvy, and in animals maintained on a diet deficient in Vitamin C. They also

note that low Vitamin C levels were found in the blood of patients with periodontal disease and rarefaction of the alveolar bone not solely attributable to local inflammatory processes.

In a U. S. Public Health Report⁷⁴ Cady quotes evidence for the view that much disease of the periodontal tissue is due to a sub-scorbutic condition. Becks⁷⁵ found faulty diets in 100 cases of tooth-root resorption; they were low in Vitamins C and D, and there was a disturbance in the calcium-phosphorus ratio. East⁷⁶ notes that the season most remote from summer shows the highest incidence of dental caries, and that improving the diets of children under his observation seemed to lessen the incidence of the disease. Privitera⁵⁷ fed a multiple vitamin and mineral supplement to children already on a good diet over a period of six months; at the end of this time but one-quarter the number of dental cavities had developed in this group, as compared with a control group. Hanke's studies on 191 dental patients⁷⁷ disclosed Vitamin C deficiency in the majority; many were treated successfully with citrus fruits.

Vitamin C and Dentine Formation

While the adult or fully erupted tooth is not as a whole

subject to modifications in structure or calcification by variations in the calcium metabolism, the growing tooth is characteristically sensitive to such changes, which are in turn dependent, in part at least, on vitamin and other dietary factors.⁷⁸ In growing teeth, lack of Vitamin C interferes with the formation of dentine, cementum, and enamel, and the pulp becomes separated from the dentine by liquid produced by the odontoblasts.⁷³ Hence the need for an adequate vitamin and mineral supplement to the diet of the mother during pregnancy, and to that of the infant during its first months of life.

Vincent's Infection

The course of other oral diseases may depend in part upon the existence of a deficiency state. Vincent's infection of the mouth is usually considered a distinct clinical entity caused by a specific organism, but there is considerable evidence that dietary deficiencies may be a predisposing cause. In a study of patients with such deficiencies Cady⁷⁴ found that 80 per cent were suffering from Vincent's infection. Williams⁷⁹ notes that when the juices of citrus fruits were added to otherwise adequate diets, the percentage of gingivitis in the groups studied showed a marked fall. In 22 patients with Vincent's infection who received Vitamin C in

addition to local treatment there was either clinical improvement, or a marked decrease in the relative number of spirilla in the smears, or both. Of a control group of 11, only one patient showed improvement.

Vitamins and Sound Teeth

In a review of 98 studies on nutrition in relation to dental disease, Todhunter and Sparling⁸⁰ conclude that for the development of sound teeth and the prevention of dental caries, a balanced diet rich in vitamins and with a high mineral content is required. Howe⁸¹ states: "It is generally conceded that pyorrhea is not a distinct entity, but is a symptom of an anomalous metabolic condition. There is sufficient evidence to indicate that the dental disaster of today is largely due to mineral and vitamin deficiencies."

Citrus fruits provide vitamins and minerals to help compensate for the lack of these substances in our modern diet of concentrated and refined foods.

Citrus Stimulates Oral Secretions

Many investigations have shown that while strongly antiseptic mouthwashes may free the mouth from bac-

teria rapidly, the incidental injury to the superficial layers of the buccal mucosa provides an excellent breeding ground for germs, and that two hours after the use of such antiseptics bacterial flora are present in far greater numbers than before the treatment. The use of citrus juice, on the other hand, definitely diminishes the amount of germ life present two hours after its use.

In European and Latin-American countries it is a prevailing custom to eat fruit at the end of a meal. The fruit acts mechanically to remove food particles from the teeth and gums, and its tartness, particularly in the case of citrus fruits, stimulates the glands of the buccal mucosa to pour forth abundant secretion which tends to clear the surfaces by washing away bacteria and food particles. Fruit as the final course of a meal also produces a sense of well-being by leaving the mouth cool and pleasantly refreshed.

Thus citrus fruits aid in maintaining normal conditions in the mouth, and in promoting dental health.

D I S E A S E

In sickness and in health, the problem of a suitable diet is an ever-present one. Man owes his persistence on this planet to his ability, unexcelled in the animal kingdom, to survive on a diet varying widely in quantity from time to time, and derived from an infinite variety of sources. Mere existence, however, does not imply optimum or buoyant health. To achieve the state of fitness which Lord Horder has defined as "Health plus Happiness," the diet must be adequate in amount and well-balanced, the food intake adjusted in quality and quantity to the current and prospective energy output, and the requirements of the organism fully met with regard to certain accessory factors of vital importance, the vitamins and mineral salts.

Frequent Intake of Vitamin C is Necessary

In times of plenty the body stores food against future needs, some food substances being retained in relatively greater amounts than others. Energy producing foods are deposited in the form of glycogen and fat,

often to the point of obesity, while the stores of most of the accessory substances are exceedingly small. Of the latter, Vitamin C is utilized so rapidly that the stores must be maintained by frequent intake if optimum health is to prevail. The prophylactic value of these accessory substances is an established fact, based on sound clinical and experimental studies.

Illness Causes Rapid Use of Vitamin C

In most illnesses there is apparently a more rapid utilization of Vitamin C and an increased demand for it; this may be true of other accessory substances as well. Lack of these substances undoubtedly opens the way to infection and interferes with the healing of tissue lesions, and it may enhance the morbidity of other disease processes. There is probably a very high incidence of deficiency states accompanying bacterial and other disease, surgical disabilities, toxemia whether endogenous or exogenous, and all states of increased metabolic activity.

Vitamins Specific for Results of Vitamin Lack

However, a careful study of the literature forces the conclusion that although the vitamins have been em-

ployed in the treatment of practically every known disease, they are *specific* treatment solely for those conditions brought about by the lack of vitamins in the animal economy; and only when the pathologic processes due to avitaminosis have still to reach the irreversible stage can such treatment be expected to result in cure.

It is in the deficiency states associated with other disease that accessory substances are most often of therapeutic value; and while at the outset of treatment it may be necessary to employ the concentrated principles to achieve sufficiently high dosage, subsequent care and the treatment of milder deficiency states may best be accomplished through the use of natural foods such as the citrus fruits.

Digestive Diseases

Achlorhydria appears to be associated with Vitamin C deficiency, in anemias of both the pernicious and the iron deficiency types.⁸² Sansum and Gray report successful treatment of achlorhydria by the administration of sour citrus juices. In a series of experimental studies on rats and children, Robertson⁸³ found that diets low in calcium and potassium caused intestinal

stasis, and loss of gastro-intestinal motility as shown by the X-ray; the constipation was relieved when these mineral salts were restored to the diet. The author suggests that calcium deficiency may predispose to the formation of fecaliths and the development of appendiceal infection.

High Vitamin Therapy Necessary

In the treatment of diseases of the digestive tract large amounts of vitamins or vitamin containing foods should be given.⁸⁴ In these conditions there is often limited vitamin intake, and poor absorption and assimilation. Moreover, adsorbents, such as aluminum hydroxide, which are frequently employed in treatment, may remove from the digestive tract so large a proportion of the vitamins present as to create, over a period of time, a state of vitamin deficiency.

INCREASED METABOLIC STATES

Fatigue Reduces Vitamin C Content

In both animals⁸⁵ and man⁸⁶ fatigue has been shown to reduce the Vitamin C content of the body. Some of the vitamin is also lost through perspiration.⁸⁷ In a study of 110 children on an institution diet, Lemmel⁸⁸ gave half of them an increased allowance of Vitamin C over a period of 4 months. At the end of that time the general liveliness and capacity for work of the two groups was assayed by teachers unaware of the nature of the experiment, who reported that the treated group showed four times the improvement of the control group.

Hyperthyroidism Increases Need for Vitamin C

In conditions of over-activity of the thyroid the increased metabolism of the body is reflected in an enhanced demand for vitamins and mineral salts. In animals with experimental hyperthyroidism the ad-

ministration of suitable doses of Vitamin C prevented a fall of muscle and liver glycogen and contributed to the well-being of the animal.⁸⁹ Carrière, Morel and Gineste⁹⁰ treated hyperthyroid patients with Vitamin C and found that those with mild or moderate degrees of the disease were benefited, while those in the more severe stages did not respond to the treatment. In hyperthyroidism, as in other states of increased metabolism, the greater demand for Vitamin C calls for a larger supply in the diet.

Citrus Indicated in Fevers

It is suggested that in all conditions where the metabolic rate is increased, an adequate supply of vitamins and minerals be provided, in concentrated form when necessary, and routinely in natural foods such as the citrus fruits. In fevers especially the citrus fruits are indicated, since their health-giving qualities are combined in such tempting and refreshing form that they are acceptable when no other food is tolerated.

T O X E M I A S

Alcoholism Disturbs Digestive Functions

In alcoholism as in all toxic states the vitamin stores of the body are depleted and the demand increased. Moreover, the chronic alcoholic characteristically shuns a normal diet and exists for long periods upon alcohol plus a small amount of meat or other concentrated nutriment notably lacking in vitamins and minerals. Such a diet inevitably results in profound disturbances of the digestive functions, and marked interference with absorption and assimilation of essential food substances. Hence alcoholics frequently present advanced stages of deficiency disease.

Alcoholics Lack Vitamin C

Wortis, Wortis and Marsh have shown⁹¹ that alcoholics with peripheral neuritis and with psychosis tend to have a subnormal content of Vitamin C in the blood and spinal fluid, and suggest that the vitamin may play a role in the metabolism of nervous tissue. Alexander,

Pijoan, Schube and Moore⁹² found the blood plasma content of Vitamin C low in alcoholics, and consider this a factor in the occurrence of the epidural, subdural and intracerebral hemorrhages so frequently observed in alcoholics after relatively slight trauma. Alcoholics with a clinical picture suggesting pellagra are found in every public hospital.

The treatment of these conditions is largely a matter of improving the diet, and citrus products are a valuable factor in restoring the vitamin balance to normal.

S U R G I C A L D I S E A S E S

Citrus Juice Preceding Anesthesia and Operation

Anesthesia, like alcohol, tends to lower the vitamin content of the organism and to cause acidosis.^{93,94} Harms⁹⁵ prepared his patients by administering large quantities of citrus juice during the 24 hours preceding anesthesia, and noted less post-operative nausea and depression.

Vitamin C Aids Repair of Wounds

The repair of wounds, accidental or surgical, is dependent upon the ability of the body to produce and maintain fibrous tissue, and this in turn depends upon an adequate supply of Vitamin C.⁴⁴ Lanman and Ingalls⁹⁶ noted spontaneous breakdown of uninfected wounds in patients with the cachexia of cancer, debility, and with gastro-intestinal disease, and correlated it with a lack of Vitamin C in the body. Animal experiments proved their contention that Vitamin C is essential in the healing of wounds. Their findings have been confirmed by Taffel and Harvey.⁹⁷

For Convalescence of Surgical Patients

Metheny,⁹⁸ Lauber and Rosenfeld,⁹⁹ and Vorhaus¹⁰⁰ stress the importance of vitamin and mineral therapy in the preparation and convalescence of the surgical patient.

Whipple and Elliott¹⁰¹ state that many elderly and cachetic people show evidence of prolonged malnutrition, and that such deficiencies unquestionably predispose to wound disruption even in the absence of infection.

Vitamins Essential to Integrity of Protoplasm

Ivy¹⁰² notes that in surgical practice one should bear in mind the possibility of vitamin deficiency whenever there is a gastro-intestinal disturbance, an increase in the metabolic rate, or an increase in the growth and reparative processes, and states that vitamins are as essential in building, maintaining, and repairing protoplasm as are minerals and other foods.

The diet in surgical disease should be carefully considered with respect to the patient's condition, and made as complete as possible with regard to an adequate supply of vitamins and minerals. Citrus juices

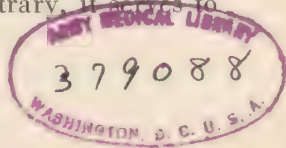
are rarely contra-indicated, and afford the patient refreshment as well as a supply of food factors needed in the healing process.

THE INFECTIONS

In most if not all of the infections there is increased demand for the vitamins and minerals.^{20,24,103} Several factors combine to bring this about: the toxic process, increased metabolism due to fever, impaired absorption and assimilation, and curtailment or readjustment of the diet, all play a part.

Amelioration of Deficiency States

Reports in the medical literature would seem to show that almost every known disease has been treated with vitamins, usually, according to the authors, with success. However, controlled animal experiments and clinical studies prove that vitamins are specific therapy solely for pathologic conditions brought about by vitamin lack. Hence the cures attributed to vitamin therapy in bacterial disease are probably due to amelioration of accompanying deficiency states, with consequent strengthening of the body's recuperative powers, and spontaneous remission of the disease. This explanation does not detract from the value of the accessory substances in therapeutics. On the contrary, it accords to



remind us that few diets are carefully balanced, that special diets for the sick are often lacking in many of the substances which the patient needs for his recovery, and that in general these vitamins and minerals may best be provided through the medium of natural foods.

Arthritis

Arthritis in its various forms has received considerable attention from the nutritional standpoint. Rinehart and his collaborators⁵⁵ showed that animals deficient in Vitamin C were more susceptible to various infective agents producing arthritis than were animals in a state of Vitamin C balance. In human patients with rheumatoid arthritis they found the Vitamin C level of the blood plasma uniformly and severely reduced.¹⁰¹ They believe that Vitamin C deficiency is an important factor in the etiology of the disease, and both they and Hare and Williams¹⁰⁵ have noted clinical improvement when their patients received adequate quantities of the vitamin. In Sherwood's series of 50 cases of chronic arthritis,¹⁰⁶ all had low ascorbic levels. Improvement on treatment with Vitamin C was always preceded by return of the Vitamin C levels to normal. He feels that the symptoms of both atrophic and hypertrophic arthritis are due to diminished local circulation and local edema, and that these are increased by

reason of subnormal Vitamin C concentration in the body. He urges giving large amounts of the vitamin as a routine therapeutic measure.

Rheumatic Fever

In rheumatic fever there is usually a vitamin deficiency, more severe in the acute stage of the disease, and especially so in children.^{55,107,108,109} Abbasy, Hill and Harris¹⁰⁸ state: "The most reasonable interpretation is that with the underlying infection there is a greatly increased metabolic use of (and need for) Vitamin C, with a correspondingly lowered degree of saturation of the body tissues." Although there is no evidence that saturation of the body with Vitamin C reduces the incidence of recurrent attacks of rheumatic manifestations, it seems unreasonable to suppose that an organism in a deficiency state can offer maximum resistance to the inroads of disease; hence it seems advisable on general principles to feed rheumatic patients with a balanced diet rich in vitamins and minerals.

Heart Disease

In heart disease also there is often a vitamin deficit, with, frequently, improvement when the debt is paid. Rinehart's cardiac children⁵⁵ showed a large weight

and health gain after the addition of 8 to 16 ounces of citrus juice to their diet. Evans¹¹⁰ and Stefanutti,¹¹¹ working with patients in cardiac failure, found that the administration of Vitamin C caused diuresis and consequent clinical improvement. Evans recommends the administration of Vitamin C to all patients in heart failure, either as the pure substance or in the form of orange or lemon juice.

Tuberculosis

Tuberculosis increases the demand for vitamins in both man and animals. The literature relating to experimental animals indicates a decreased resistance to tuberculous infection when there is Vitamin C deficiency. Animals with chronic progressive tuberculosis are more easily precipitated into scurvy. Partial depletion of Vitamin C shortens the lives of tuberculous guinea pigs. Clinical reports state that scurvy renders a patient increasingly susceptible to tuberculosis. Martin and Heise¹¹² studied the Vitamin C excretion of 150 tuberculous patients with the following conclusions: a) hypovitaminosis C was the rule; b) the degree of the hypovitaminosis paralleled the extent and activity of the tuberculous process; c) the hypovitaminosis was attributed to both an increased requirement for Vitamin C, and abnormal functioning of the intestinal

tract causing either poor absorption of the vitamin or its destruction by bacterial action. Similar studies by Bumbalo and Jetter¹¹³ and others confirm the finding that Vitamin C levels are low in tuberculosis; this is probably true of other accessory substances as well. Diets high in the vital factors of vitamins and minerals are rational therapy.

Pneumonia

In pneumonia also Vitamin C levels are low.¹¹⁴ Of the treatment of pneumonia in children, Gerstley¹¹⁵ says: "Carbohydrate in adequate amounts is life-saving. The child should be offered the carbohydrate of which he takes the most. The fruit juices are often the best vehicles; grapefruit juice is especially advantageous."

Wasting Diseases

In diphtheria, tonsillitis, otitis media, osteomyelitis, typhoid, genito-urinary diseases, poliomyelitis, and many other febrile and wasting diseases, deficiency states are concomitant and complicating factors. Whooping cough is of peculiar interest: Omerod and Unkauf¹¹⁶ found that treatment with Vitamin C caused marked reduction of the vomiting, night-cough, and number and intensity of the whoops, shortening the recovery time from weeks to days. Their observations

were confirmed by Harley,¹¹⁷ Bradshaw and others. It appeared that this might indicate a specific therapeutic effect of the vitamin on bacterial disease, but further study has shown that Vitamin C acts by abolishing a deficiency state accompanying the pertussis, thus enhancing the ability of the organism to combat the disease.

Common Cold

The common cold has been treated with citrus juices for so long a time that it has become folk-lore, and there are few references to such treatment in the literature. Lemons and oranges are most frequently prescribed in this connection, probably because they are longest and best known.

Grapefruit, the comparative newcomer among citrus fruits, has its own points of superiority, its sharp, clean taste tending to provoke the appetite and cause it to be taken in larger quantities, a desideratum in this disease.

In all of the illnesses enumerated above, citrus fruits are acceptable and refreshing means of providing much needed vitamins and minerals, even when the concentrated substances must be employed at the outset to achieve sufficiently high dosage.

RESISTANCE TO INFECTION

“The best germicide is a healthy body”; this old saying gathers new support from modern research in the field of nutrition. That diet may influence resistance to infection is a comparatively new idea, dating from about 1900, and numerous studies during the past few decades have supported the hypothesis by sound factual data. It is reasonable to suppose that an organism weakened by a deficiency state is more susceptible to infection, and there is considerable evidence in the literature to that effect.

Lack of Vitamin C Impairs Defense Mechanism

In a review of the literature Clausen¹¹⁸ states that resistance to infection may be greatly reduced by deficient diets, particularly those deficient in Vitamins A and C. Martin and Heise¹¹² note that lack of Vitamin C in the diet lowers the resistance to infection with tuberculosis, in both man and animals. Rinehart⁵⁵ states that the defense mechanism of Vitamin C defi-

cient animals is impaired, and that the ability to localize the infecting organism is less effective. Meyer¹¹⁹ states that in infants the tendency to develop repeated infections is markedly lessened by the administration of 50 to 100 c.c. of orange juice daily.

Since there appears to be general agreement that a deficiency state predisposes to infection, it should be within the province of the physician to consider carefully the patient's diet and to make sure that it contains ample quantities of those natural foods endowed richly with vitamins and mineral salts. Among them citrus fruits will find a place in every schedule.

Hemorrhagic States

Purpura and Anemia. Hemorrhage from the mucous membranes is a classic sign of scurvy, and anemia often accompanies it. Wolbach's characterization of scurvy as the inability of the supporting tissues to produce and maintain intercellular substance⁴⁴ turned the attention of a number of investigators to a reconsideration of purpura and the hemorrhagic states, and their studies have thrown much light on the subject. Rivers and Carlson,⁴³ studying patients with peptic ulcer, observed that in cases in which hemorrhage had

occurred the Vitamin C content of the blood and urine was less than normal; treatment with Vitamin C brought marked improvement. Wilder and Wilbur¹²⁰ feel that low Vitamin C intake predisposes to hemorrhage, and point out that recent studies indicate the need for large doses of the vitamin in treatment. Other investigators^{54,121,122} have found Vitamin C deficiency in purpuric conditions, and have successfully used the vitamin in treatment. Witts¹²³ effectively summarizes our knowledge in this field by stating that Vitamin C treatment is of specific value only in the hemorrhagic states of overt or latent scurvy, and is not a general remedy for all of the hemorrhagic states.

Vitamin C Improved Anemia

The same principle apparently holds true for the formation of new blood cells. Rohmer and his associates¹²⁴ found that in animals hematopoiesis decreased steadily when Vitamin C was withheld, and was resumed within 24 to 48 hours after the vitamin was restored to the diet. In 16 anemic infants low in Vitamin C, the anemia improved rapidly after the administration of the vitamin. v.Euler and Malmberg¹²⁵ note that the anemia accompanying scurvy in guinea pigs was counteracted by treatment with Vitamin C. Radford, deSavitsch and

Sweany¹²⁶ treated 74 tuberculous patients with 250 mgm. ascorbic acid or 500 c.c. orange juice daily for a period of 9 months. As compared with a control group, these patients showed a more favorable course as judged by the increased hemoglobin and red cell count, and the general blood picture. Mettier, Minot and Townsend³⁶ state: "Food rich in Vitamin C can rapidly effect erythropoiesis in scurvy, for we have observed 5 cases in which this occurred." In every case of anemia, a deficiency state should be suspected; vitamins and minerals are indicated in its treatment, along with the usually prescribed medications.

C O N C L U S I O N

Deficiency states, particularly with regard to the vitamins and mineral salts, are of common occurrence.

Most deficiency states are multiple; deficiency in a single essential food factor is rarely found. But while beriberi and frank scurvy are not often observed, the mild, partial, subclinical type of vitamin or mineral lack is frequently seen, and because of its widespread occurrence is of great medical and economic importance.

Man may exist on a low intake of these essential substances, but vigorous, buoyant health requires of some vitamin and mineral factors a supply several times the minimum protective dose.

On a low intake level the individual may appear well, but a special strain such as accident, disease, or pregnancy may precipitate an acute deficiency state.

In infancy, growth, muscular activity, pregnancy, lactation, injury, infection, toxemia of endogenous or

exogenous origin, and in any condition of heightened metabolic activity, there is increased utilization of and demand for the vitamins and minerals.

In certain illnesses, particularly those of the gastrointestinal tract, absorption and assimilation of some of these substances may be markedly diminished.

The treatment of a deficiency state requires a vitamin and mineral intake many times larger than that needed for normal maintenance in health, continued for a sufficient length of time to restore the depleted reserves of the organism.

In acute conditions or severe deficiency states vitamins and minerals may need to be supplied in pure or concentrated form to achieve sufficient dosage. In milder deficiency states and in health the pure principles have no advantage over appropriate natural foods. The latter may even be superior, since it is probable that such foods contain other essential food-factors as yet undiscovered.

“Today’s knowledge does not permit us to prescribe with precision the amounts of the 36 or more substances which are required for correct nutrition. To detect deficiencies and remedy them piecemeal by sup-

plements of manufactured concentrates will not at present solve the problem.”²⁴

“The essential principles of nutrition established by research are that green vegetables and fruits are not luxuries but necessities . . . ”¹²⁷

“Their content of vitamins, minerals, organic acids, sugar and water, together with their final alkaline reaction in the body, makes them (citrus fruits) most valuable in helping to meet the requirements of a well-balanced diet, the principles of which should be observed in every routine hospital diet, and not violated in a special diet . . . Their flavor and tartness make them acceptable when other foods cannot be taken.”²⁷

SUGGESTED DIETARY USES OF CITRUS FRUITS

Breakfast

Juice of two oranges slightly chilled.

Juice of one grapefruit slightly chilled.

Juice of one orange and half grapefruit.

Half or whole grapefruit, eaten with spoon.

Two tangerines.

Lunch and Dinner

Juice of one grapefruit, slightly chilled.

Grapefruit segments in fruit cup.

Grapefruit segments in fruit salad.

Mixed orange and grapefruit segments.

Grilled grapefruit.

Half grapefruit as entree or dessert.

Fruit segments cooked with meat.

Fruit segments as garnish.

Mid-Afternoon

Iced grapefruit or orange juice, or mixture, as thirst-quencher and "pick-me-up."

Tangerines in abundant supply for children. (Easily peeled.)

Before Retiring

Chilled grapefruit juice as "nightcap."

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